

IP20 Rec'd PCT/PTO 03 APR 2006

1 Variable Vibrator Mechanism

2

3 The present invention relates to a variable vibrator
4 mechanism for use in machinery, especially, but not
5 exclusively, for use in vibrating screen and
6 vibrating feeder machines in the re-cycling and
7 quarrying industries.

8

9 References herein to a vibrating screen machine are
10 understood to mean any vibrating machine which
11 separates loose material according to its particle
12 size, and references herein to a vibrating feeder
13 machine are understood to mean any vibrating machine
14 which feeds material to an apparatus. Both of these
15 machines are well known in the field, and therefore
16 no further explanation will be given here.

17

18 Conventional vibrator mechanisms used in vibrating
19 horizontal screens and vibrating feeders operate on
20 the principal of eccentric weights located on
21 counter rotating shafts which generate a resultant
22 vibration of the mechanism which is translated to

1 the screens and feeders. The amplitude and
2 direction of the resultant vibration can be altered
3 to suit the characteristics of feed material by
4 varying the rotational displacement between the
5 eccentric weights and/or varying the mass of the
6 eccentric weights. Altering the amplitude and
7 direction of the resultant vibration of the
8 mechanism involves stopping the machinery, removing
9 the covers of the drive mechanisms, and physically
10 changing the rotational displacement and/or mass of
11 the weights. This typically involves between four
12 and eight hours work by two skilled technicians,
13 with an inherent safety risk due to nature of the
14 drive mechanism, along with a loss of production due
15 to the downtime of the machine.

16
17 It is an object of the present invention to provide
18 a vibrator mechanism which obviates or mitigates one
19 or more of the disadvantages referred to above.

20
21 According to a first aspect of the present invention
22 there is provided a variable vibrator mechanism
23 comprising:

24 a first member and a second member arranged
25 telescopically with one another,

26 wherein said first member has a first eccentric
27 weight and said second member has a second eccentric
28 weight,

29 wherein said first and second members are
30 adapted to be engaged with one another, such that
31 the rotational displacement between said first
32 eccentric weight and said second eccentric weight

1 may be varied by varying the longitudinal
2 displacement between said first and second members.
3

4 Preferably, the second member is adapted to
5 telescopically receive the first member.
6 Alternatively, the first member is adapted to
7 telescopically receive the second member.
8

9 Preferably, the first and second members are adapted
10 to be threadably engaged with one another.
11

12 Preferably, the first and second members are
13 cylindrical.
14

15 Preferably, the variable vibrator mechanism
16 comprises two first members arranged telescopically
17 with said second member, wherein the two first
18 members and the second member are adapted to be
19 engaged with one another, such that the rotational
20 displacement between the first eccentric weights and
21 the second eccentric weight may be varied by varying
22 the longitudinal displacement between the first
23 members and the second member.
24

25 Preferably, the variable vibrator mechanism further
26 comprises means for telescopically displacing the
27 first and second members. Preferably the means for
28 telescopically displacing the first and second
29 members is a hydraulic ram. Alternatively, the
30 means for telescopically displacing the first and
31 second members is mechanically driven shaft.
32

1 Preferably, the variable vibrator mechanism
2 comprises a plurality of pairs of first and second
3 members, wherein each pair of first and second
4 members are arranged telescopically with one
5 another. More preferably, the variable vibrator
6 mechanism comprises two pairs of first and second
7 members. More preferably, the variable vibrator
8 mechanism comprises three pairs of first and second
9 members.

10

11 Preferably, the variable vibrator mechanism is
12 constructed of metal.

13

14 According to a second aspect of the present
15 invention, there is provided a vibrating screen
16 machine including a variable vibrator mechanism in
17 accordance with the first aspect of the present
18 invention.

19

20 According to a third aspect of the present
21 invention, there is provided a vibrating horizontal
22 or inclined feeder machine including a variable
23 vibrator mechanism in accordance with the first
24 aspect of the present invention.

25

26 Embodiments of the present invention will now be
27 described, by way of example only, with reference to
28 the accompanying drawings, in which:-

29

30 Fig. 1 is a perspective exploded view of a variable
31 vibrator mechanism in accordance with the present
32 invention;

1 Fig. 2 is a perspective view of an assembled
2 variable vibrator mechanism;
3 Fig. 3 is a perspective view of a variable vibrator
4 mechanism of Fig. 2 further including an outer
5 bearing, housing and cap plate;
6 Fig. 4 is a perspective view of a variable vibrator
7 mechanism of Fig. 3 further including a drive gear;
8 Fig. 5 is a perspective view of a variable vibrator
9 apparatus including three variable vibrator
10 mechanisms of Fig. 4;
11 Fig. 6 is a cross-sectional view of the variable
12 vibrator apparatus of Fig. 5 along line I-I of Fig.
13 5;
14 Fig. 6a is an enlarged view of one end of the
15 variable vibrator mechanism of Fig. 6;
16 Figs. 7a and 7b are perspective part cut-away views
17 of the variable vibrator apparatus of Fig. 1;
18 Figs. 7c and 7d are schematic end views of the
19 variable vibrator mechanism of Figs. 7a and 7b,
20 respectively;
21 Fig. 8a is a schematic end view of the variable
22 vibrator mechanism of Fig. 2, wherein the eccentric
23 weights of the first and second members are
24 rotationally offset to a maximum position from one
25 another;
26 Fig. 8b illustrates the operation of three counter
27 rotating variable vibrator mechanisms of Fig. 8a,
28 and shows the resultant displacement of the
29 vibration at each quarter turn of rotation;
30 Fig. 8c illustrates the resultant vibration path of
31 Fig. 8b;

1 Fig. 9a is a schematic end view of the variable
2 vibrator mechanism of Fig. 2, wherein the eccentric
3 weights of the first and second members are
4 rotationally offset to a minimum position from one
5 another;

6 Fig. 9b illustrates the operation of three counter
7 rotating variable vibrator mechanisms of Fig. 9a,
8 and shows the resultant displacement of the
9 vibration at each quarter turn of rotation;

10 Fig. 9c illustrates the resultant vibration path of
11 Fig. 9b;

12 Fig. 9d illustrates the range of vibration paths
13 available between the maximum and minimum vibration
14 paths of Figs. 8c and 9c; and

15 Fig. 10 is a perspective view of the variable
16 vibrator apparatus of Fig. 5 as attached to a
17 typical vibrating horizontal screen.

18
19 Referring to Fig. 1, a variable vibrator mechanism
20 10 comprises a pair of first members 12 and a second
21 member 14 arranged telescopically with one another.
22 That is to say the pair of first members 12 and the
23 second member 14 are arranged to be received wholly
24 or partly within one another.

25
26 The second member 14 is substantially cylindrical
27 with a second eccentric weight 16 located on its
28 outer circumferential surface 18 and two opposite
29 spiral keyways 20 (see Fig. 6) cut into its inner
30 circumferential surface 24. That is to say the
31 second member 14 has a weight 16 which is offset
32 from its central axis. The second eccentric weight

1 16 is illustrated in Fig. 1 as two separate weights
2 located at opposite ends of the second member 14.
3 However, it should be appreciated that the second
4 eccentric weight 16 could be one continuous member
5 offset from the central axis.

6
7 The first members 12 are also substantially
8 cylindrical with first eccentric weights 26 located
9 on their inner circumferential surfaces 28 and
10 spigots 30 located on their outer circumferential
11 surfaces 32. The first members 12 are also provided
12 with bores 34 therethrough.

13
14 The first members 12 are rotatably mounted on
15 hydraulic ram shafts 36a by bearings 38. The
16 bearings 38 are mounted on the ram shafts 36a within
17 the bores 34 of the first members 12 and each is
18 held in place with respect to the first member 12 by
19 a first circlip 42 and a shoulder 13 on the first
20 member 12, seen most clearly in Figs. 6 and 6a.
21 Each bearing 38 is located on the ram shaft 36a by
22 two second circlips 44, also seen most clearly in
23 Figs. 6 and 6a. Arranging the bearings 38, first
24 circlips 42 and second circlips 44 in this manner
25 prevents any longitudinal movement of the first
26 members 12 on the hydraulic ram shafts 36a. As will
27 be understood by the skilled person, other suitable
28 types of bearing arrangements may be used as
29 bearings 38, e.g. tapered roller bearings.

30
31 The hydraulic rams 36 comprise a piston shaft 36a
32 and a piston housing 36b (as best illustrated in

1 Fig. 6). The piston housings 36b further comprise
2 hydraulic inlet and outlet ports 36c and 36d. The
3 inlet and outlet ports 36c and 36d facilitate the
4 hydraulic operation of the piston shafts 36a.

5
6 The piston housings 36b are surrounded by end stubs
7 46 which rotate with the second member 14. The
8 hydraulic rams 36 and the end stubs 46 are sealed to
9 each other by radial shaft seals 48 which are
10 mounted in housings 50, so that the end stub 46 can
11 rotate relative to the piston housing 36b. Housings
12 50 are located and fixed in recesses 52 of the end
13 stubs 46, and sealed with an o-ring 50a. The end
14 stubs 46 are substantially cylindrical with flange
15 portions 54 secured to the second member 14.

16
17 The left hand end stub 46 in Fig. 6 is fixed to a
18 drive gear 68 and is fixed longitudinally with
19 respect to its corresponding ram 36, while the right
20 hand end stub 46 in Fig. 6 is free to move
21 longitudinally with respect to its corresponding ram
22 36, to allow for thermal expansion.

23
24 Referring to Figs. 6 and 6a, the outer surface of
25 each ram 36 has a flange 136 which is connected to a
26 ram mounting plate 138 by bolts or the like, which
27 in turn is bolted to the outer cover 78. In this
28 way the hydraulic ram housing 36b is fixed and the
29 ram shaft 36a is free to move under hydraulic
30 control axially with respect to the housing 36b. It
31 is to be understood that variations in the ram
32 arrangement are possible so that the ram shaft 36a

1 is fixed and the housing 36b moves, with appropriate
2 redesign of the ram 36 and connections, as will be
3 understood by the skilled person.

4
5 The variable vibrator mechanism 10 comprises a set
6 of two first members 12 and hydraulic ram shaft
7 assemblies 36 to ensure balance across the vibrator
8 mechanism during operation. Spiral keyways 20 are
9 oppositely cut into the second member 14 to ensure
10 that the movement of the first members 12 along the
11 second member 14 is balanced.

12
13 With reference to Figs. 1 and 2, the first members
14 12 and the hydraulic ram shaft assemblies 36 are
15 mounted within the second member 14 by firstly,
16 locating the spigots 30 of the first members 12
17 within the spiral keyways 20 of the second member
18 14, and secondly, by securing the flange portions 54
19 to the second member 14 by bolts 56, or other fixing
20 means, located on the outer edges of flange portions
21 54.

22
23 As illustrated in Fig. 3, an outer bearing housing
24 58 is fitted to one end of the variable vibrator
25 mechanism 10. The outer bearing housing 58 includes
26 an outer bearing 60 which is located in a recess 62
27 of the outer bearing housing 58 and held in place by
28 a cap plate 64. The cap plate 64 is fixed to the
29 outer bearing housing 58 by bolts 64a, or other
30 fixing means. A radial shaft seal 66 is fitted into
31 a recess in the cap plate 64, whilst an o-ring (not

1 shown) is fitted between the outer bearing housing
2 58 and the cap plate 64.

3
4 As illustrated in Fig. 4, a drive gear 68 is fitted
5 over the end stub 46 and held in place by fixing
6 bolts 68a, or other fixing means. The drive gear 68
7 butts against the corresponding end stub 46 and is
8 prevented from longitudinal movement thereto. As
9 best seen in Figs. 6 and 6a, a radial seal 66 seals
10 between the end stub 46 and the cap plate 64.

11
12 The complete vibrator apparatus 72 is illustrated in
13 Fig. 5. As seen in Fig. 5, the cover 76 is cut-away
14 to show a typical drive pulley arrangement. As
15 shown, the complete vibrator apparatus 72 comprises
16 three variable vibrator mechanisms 10 arranged in a
17 row. The variable vibrator mechanisms 10 are
18 mounted to the vibrator housing 74 by means of bolts
19 74a between the outer bearing housing 58 and the
20 vibrator housing 74. An o-ring (not shown) is
21 fitted between the outer bearing housing 58 and the
22 vibrator housing 74. The complete vibrator
23 apparatus 72 (see Fig. 10) further comprises a cover
24 76 which encases the drive gears 68, and a screen 80
25 which carries the feed material (not shown) which is
26 connected to the complete variable vibrator
27 apparatus 72. Although the complete vibrator
28 apparatus 72 is illustrated as comprising three
29 variable vibrator mechanisms 10, it should be noted
30 that it may contain any number of variable vibrator
31 mechanisms 10. The variable vibrator apparatus 72
32 is driven, and thus the variable vibrator mechanisms

1 10 rotated, in a conventional manner by driving one
2 of the mechanisms 10. Fig. 5 shows an example of a
3 manner of driving. A hydraulic motor (not shown)
4 drives a driver pulley 90 on arm 94, which in turn
5 uses a drive belt (not shown) to drive a driven
6 pulley 92 fitted to a mechanism 10 to drive the end
7 stub 46.

8
9 Fig. 6 is a cross-sectional view of a variable
10 vibrator mechanism 10 within the complete vibrator
11 apparatus 72 along line I-I of Fig. 5, and Fig. 6a
12 is an enlarged view of one end of the variable
13 vibrator mechanism 10 of Fig. 6. Figs. 7a and 7b
14 are perspective part cut-away views of the variable
15 vibrator apparatus 10. Fig. 6 shows the two
16 opposite spiral keyways 20 of the second member 14.
17 Fig. 6 also shows the internal operation of the
18 hydraulic ram shafts 36.

19
20 As seen in Figs. 6, 7a and 7b, when hydraulic
21 pressure is applied to the piston housing 36b, via
22 inlet ports 36c, the piston shafts 36a move the
23 first members 12 towards the centre of the second
24 member 14. As this happens the first and second
25 members 12 and 14 threadably engage. The spigots 30
26 follow the spiral keyways 20 and rotate the first
27 members 12 about the hydraulic ram shafts 36, thus
28 varying the rotational displacement between the
29 first and second eccentric weights 26 and 16. The
30 piston shafts 36a and first members 12 are moved
31 back to the edges of the second member 14 by
32 reversing oil flow from the piston housing 36b via

1 outlet ports 36d. Figs. 7c and 7d show the
2 rotational displacement between the first and second
3 eccentric weights 26 and 16 between the two
4 positions.

5
6 The hydraulic ram shafts 36 may include conventional
7 remotely operated activation units (not shown) for
8 moving the first members 12 into and out of the
9 second member 14. This method of remotely operating
10 a hydraulic system such as this is known and no
11 further explanation is given here.

12
13 The operation of the complete vibrator apparatus 72
14 will now be described with reference to Figs. 8a -
15 9d. In this configuration the first eccentric
16 weight 26 is termed the variable weight and the
17 second eccentric weight 16 is termed the fixed
18 weight.

19
20 Fig. 8a is a schematic end view of a variable
21 vibrator mechanism 10 with the first and second
22 eccentric weights 26 and 16 of the first and second
23 members 12 and 14 rotationally offset from one
24 another by approximately 90 degrees. In this
25 embodiment of the present invention, 90 degrees is
26 the maximum rotational offset between the first and
27 second eccentric weights 26 and 16. However, it
28 should be noted that first and second eccentric
29 weights 26 and 16 may be offset from one another by
30 any angle.

31

1 Fig. 8a illustrates the centripetal force components
2 acting on the first and second eccentric weights 26
3 and 16 when the variable vibrator mechanism 10 is
4 rotating. The centripetal force component of the
5 first eccentric weight 26 is given the symbol "V"
6 (variable), and the centripetal force component of
7 the second eccentric weight 16 is given the symbol
8 "F" (fixed). Also shown is the overall resultant
9 centripetal force component acting on the variable
10 vibrator mechanism 10. This resultant component is
11 given the symbol "R" (resultant).
12

13 Fig. 8b illustrates the operation of the three
14 variable vibrator mechanisms 10 of Fig. 8a. As seen
15 in Fig. 8b, the first and third variable vibrator
16 mechanisms 10 rotate clockwise, whilst the second
17 variable vibrator mechanism 10 rotates counter-
18 clockwise.
19

20 The four rows in Fig. 8b each illustrate the
21 resultant displacement vibration component after a
22 quarter-turn of the variable vibrator mechanisms 10.
23

24 The overall effect of having three counter-rotating
25 variable vibrator mechanisms 10 is to map out a
26 vibration path which is elliptical, as illustrated
27 in Fig. 8c.
28

29 Fig. 9a is a schematic end view of a variable
30 vibrator mechanism 10 with the first and second
31 eccentric weights 26 and 16 of the first and second

1 members 12 and 14 rotationally offset from one
2 another by a minimal amount.

3
4 Again, Fig. 9a illustrates the centripetal force
5 components acting on the first and second eccentric
6 weights 26 and 16 when the variable vibrator
7 mechanism 10 is rotating. In this configuration the
8 overall resultant centripetal force component acting
9 on the variable vibrator mechanism 10 is greater
10 than the previous configuration where the first and
11 second eccentric weights 26 and 16 were rotationally
12 offset from one another by approximately 90 degrees.

13
14 Fig. 9b illustrates the operation of the three
15 variable vibrator mechanisms 10 of Fig. 9a. As seen
16 in Fig. 9b, again the first and third variable
17 vibrator mechanisms 10 rotate clockwise, whilst the
18 second variable vibrator mechanisms 10 rotates
19 counter-clockwise.

20
21 Again, the four rows in Fig. 9b each illustrate the
22 resultant displacement vibration component after a
23 quarter-turn of the variable vibrator mechanisms 10.

24
25 Fig. 9c again illustrates the overall elliptical
26 vibration path. In this configuration the resultant
27 vibration path is greater than the previous
28 configuration where the first and second eccentric
29 weights 26 and 16 were rotationally offset from one
30 another by approximately 90 degrees.

31

1 The configuration of the first and second eccentric
2 weights 26 and 16 of Fig. 8a results in a minimum
3 vibration path, whereas the configuration of the
4 first and second eccentric weights 26 and 16 of Fig.
5 9a results in a maximum vibration path. The
6 vibration paths available between these two
7 configurations, the maximum vibration path 8a and
8 the minimum vibration path 8b, are illustrated in
9 Fig. 9d.

10

11 Fig. 10 illustrates the complete vibrator apparatus
12 72 of Fig. 5 as applied to a typical vibrating
13 horizontal screen 80. The vibrating screen 80
14 operates in a conventional manner which is known,
15 and as such no further description will be given
16 here.

17

18 The preferred material of construction for all metal
19 components of variable vibrator mechanism 10 is mild
20 steel or cast iron.

21

22 The variable vibrator mechanism 10 therefore
23 obviates or mitigates the disadvantages of previous
24 proposals by providing a vibrator mechanism whose
25 vibration characteristics can be varied remotely
26 without having to stop and disassemble the machinery
27 and change the rotational displacement between fixed
28 and variable weights or add/remove mass to the
29 weights. The variable vibrator mechanism 10 avoids
30 the need for skilled technicians, removes the
31 inherent safety risk and avoids the loss of
32 production due to downtime of the machine.

1
2 Modifications and improvements may be made to the
3 above without departing from the scope of the
4 present invention. For example, although the
5 variable vibrator mechanism 10 has been described
6 above as comprising a pair of first members 12, it
7 should be appreciated that the variable vibrator
8 mechanism 10 could comprise any number of first
9 members 12, including a single first member 12,
10 arranged with a single second member 14. Although
11 the variable vibrator mechanism 10 has been
12 described above as being used in a three mechanism
13 apparatus, it should be appreciated that any number
14 of variable vibration mechanisms 10 could be used in
15 a vibrator apparatus. Also, although the variable
16 vibrator mechanism 10 has been described as
17 comprising hydraulic ram shafts 36 which
18 rotationally offsets the first eccentric weight 26
19 from the second eccentric weight 16, it should be
20 appreciated that any means could be used to provide
21 this function, e.g. the hydraulic ram shafts 36
22 could be replaced with a threaded shaft which moves
23 into the second member 14 as it is rotated.
24 Furthermore, although the variable vibrator
25 mechanism 10 has been described above as having
26 first and second eccentric weights 26 and 16 which
27 can be rotationally offset from one another by
28 between approximately 0 degrees and 90 degrees, it
29 should be appreciated that these weights could be
30 offset from one another by any angle. Also,
31 although the variable vibrator mechanism 10 has been
32 described above having the first members 12 mounted

1 within the second member 14, it should be
2 appreciated that the first members 12 may
3 alternatively be mounted on the outer
4 circumferential surface, that is to say the first
5 members 12 telescopically receive the second member
6 14. Finally, although the variable vibrator
7 mechanism 10 has been described above as being
8 applied to vibrating horizontal screens, it should
9 be appreciated that the variable vibrator mechanism
10 10 could be applied to other machines which require
11 a vibration to be created from the rotation of
12 eccentric weights e.g. inclined screens, other
13 screens, vibrating feeder machines and road surface
14 hammering devices.